for its subsequent erection. The whole work of erection was successfully completed in three weeks.

The A.E.G. alternator was not in actual operation at Paris, but was rotated for exhibition purposes by a small motor. An equally large generating set was exhibited by the Helios Company, driven by a triple-expansion engine and used for the lighting of the exhibition. This machine was of special design, as the makers desired to satisfy the requirements of the exhibition authorities and also to make the alternator suitable for subsequent disposal for other purposes. Another alternator of special interest was that exhibited by the Société l'Éclairage Électrique, which generated at 30,000 volts. This was designed more as an experimental machine, to show the possibility of directly generating at very high pressure and so dispensing with step-up transformers. The alternator had only an output of 180 k.v.-a. It is interesting in this connection to recall that last February Messrs. Schuchert and Co. completed three 1500 kw. three-phase alternators generating at 20,000 volts, for supplying power to the Valtellina Railway.

M. Guilbert has collected together all the chief data of the various machines in ten tables as an appendix at the end of the book. There is also given as an appendix a series of twenty oscillograph curves showing the potential wave-forms of a number of the alternators. These, which were taken by means of M. Blondel's oscillograph, though very interesting, are hardly accompanied by sufficient data to make them of great value. A casual inspection is, however, sufficient to show that, as M. Guilbert remarks, much progress remains to be made in the construction of alternators before a practically sinusoidal potential-curve is obtained. Yet though much remains to be done, much has already been accomplished, and the manufacturer of the modern dynamo has nothing of which to be ashamed. His machines are efficient, and he has shown that he is capable of making them of a size suitable to the ever-increasing requirements, and there can be little doubt that when the time arrives he will be able to meet still greater demands. It is not likely to be long before these are made, especially for generators for traction work. But a year or two ago the Westinghouse Company built two 2700 kw. generators for the Boston Elevated Railway; one is inclined to ask what the size of the units will be when, say, the London and North-Western or the Canadian Pacific Railway is run electrically. We can only hope that it will not be long before an answer has to be given to his question; that our progress in the future will be as rapid and as sound as it has been in the past; and that the next seventy years will be as full of development and improvement as have been the seventy which have passed since Faraday "did not despair of being able to construct a new electrical machine." M. S.

OUR BOOK SHELF.

Thirteenth Annual Report of the Local Government Board, 1900–1. Supplement containing the Report of the Medical Officer for 1900–1. (London: Eyre and Spottiswoode, 1902.)

THE scientific memoirs contained in this volume are of considerable interest. Drs. Klein and Houston have investigated the behaviour of pathogenic organisms when inoculated upon various farinaceous media, and conclude that the likelihood of infection of the human subject from such source is probably remote. A number of food-stuffs were similarly examined by Dr. Klein for the presence of pathogenic organisms, with the result that none was found. Dr. Gordon has continued his studies upon the bacteriology of scarlatina, and he adduces further proof that the *Streptococcus scarlatinae* is a species distinct from other streptococci and that it may be the causative organism of this disease. Two papers are concerned with the behaviour of micro-organisms when inoculated into the soil. In the first, Dr. Houston inoculated soil with crude sewage, and found that on the whole the soil-microbes ousted the sewage ones and that the addition of sewage to soil resulted in a temporary increase only of the sewage microbes. In the second, Dr. Sidney Martin has continued his work upon the nature of the antagonism of the soil to the typhoid bacillus; this organism survives but a short time in the soil, being destroyed by the products of the putrefactive bacteria which exist therein. Dr. Klein also reports on the infection of cockles and mussels with the typhoid and cholera microbes, and shows that these organisms may persist in the interior of the molluscs for some time after the source of infection has been removed. The importance of rats in the dissemination of plague has induced Dr. Haldane to devise an apparatus for generating carbonic oxide gas for destroying these pests in plague-infected ships. This is described and some experiments with it are detailed. There is also an interesting report upon research work in connection with glycerinated vaccine lymph. The volume concludes with a number of well-executed photographs illustrating the various papers. R. T. HEWLETT.

The Flora of the East Riding of Yorkshire. By J. F Robinson. Pp. vii + 253. (London: A. Brown and Sons.) Price 7*s.* 6*d.*

THE "Flora of the North Riding of Yorkshire," compiled by Mr. J. G. Baker so long ago as 1863, furnishes a delightful account of the plants and the plant-associations of that division. Dr. F. A. Lees is responsible for a "Flora of the West Riding" which is equally successful. The present work, therefore, fills up an important gap and completes the botanical survey of the county. The enumeration of plants is preceded by a historical review of earlier compilations and a series of sketches referring to the physiography, meteorology and plant distribution of the district. These, taken in combination with the geological map, add greatly to the interest of the book. At the same time, these chapters seem capable of some improvement. The physiographical chapter brings out very clearly the interesting features of the division, the ancient lake-area now represented by a single lake and patches of marsh in the plain of Holderness, the estuary of the Humber, the Cretaceous formation of the Wolds and the mixed character of the deposits in Derwent-land. But the ecological chapter suffers by being too condensed, and "xerophiles," "pelophiles," "arenophiles" are tumbling over one another. The contrast of "xerophiles" and "pelophiles" on pp. 35, 39, represents a confusion of terms. A more detailed and localised account of the plant forms on the different alluvial deposits and an extension of the very brief indication of successive littoral colonies, as well as fuller descriptions of other local formations, might well be given, and the extra space could be more than gained by a less generous use of type and spacing in the flora proper. In the enumeration of plants, the author and his colleagues have endeavoured to sift out the aliens which are especially abundant round Hull Docks, and also the recorded localities have received personal confirmation as far as possible. The author and the Hull Scientific and Field Naturalists' Club deserve the thanks of botanists for a

compilation which represents much hard work and which will serve to stimulate interest in that division of the county, inasmuch as it indicates a somewhat unexpected wealth and variety of plant forms. Mr. J. J. Marshall has furnished a list of the mosses of the Riding.

A Revolution in the Science of Cosmology. By George Campbell. Pp. 210. (London: Sampson Low, Marston and Co., Ltd., 1902.)

IN spite of the author's description of himself as "a professor and teacher of the natural sciences for many years," this attempt to revise the generally accepted theory of planetary evolution shows a very imperfect acquaintance with scientific principles. The leading idea is that the earth was never in a molten condition, but is now undergoing the process of fusion in consequence of the pressure of the external strata on the interior mass. The sun also is declared to have once been an opaque body, and to represent more or less what the earth and other planets will become. In this connection it is only necessary to point out that while a gaseous mass contracting under the influence of its own gravity will rise in temperature, there is no ground for extending this principle to masses which are liquid or solid.

Among the other unacceptable ideas met with is that which accounts for a prehistoric change in the polar climate by supposing that the North Pole of the earth was "suddenly" turned from the sun and remained in that position for ages, having ceased for the time being to rotate on its axis (pp. 35 and 140). Again, on p. 64, speaking of the Whirlpool nebula, it is stated that "the violent agitation of the mass must result in a very low temperature," whereas a high temperature would be expected.

The author appears to have a vague idea that electricity plays an important part in the development of worlds, and that "atoms of interstellar space" represent the primary state of all matter, but he makes no contribution of value to the subject.

The Reliquary and Illustrated Archaeologist. Edited by J. Romilly Allen. Vol. viii. Pp. 287. (London: Bemrose and Sons, Ltd., 1902.) Price 12*s.* net.

STUDENTS of any branch of archæology will find something to interest them in this volume. The periodical, of which the numbers issued during the present year are included in the volume, is "a quarterly journal and review devoted to the study of the early pagan and Christian antiquities of Great Britain; mediæval architecture and ecclesiology; the development of the arts and industries of man in the past ages; and the survivals of ancient usages and appliances in the present." Notes on interesting and important papers contributed to some of the separate numbers of the *Reliquary* have already appeared in these columns, so that it is only necessary to say here that the eighth volume, with its numerous, well-produced illustrations, would make a handsome addition to the library of the student of antiquities.

Earth and Sky. A Second and Third Grade Nature Reader and Text-Book. By. J. H. Stickney. Pp. viii + 118. (Boston, U.S.A., and London: Ginn and Co., 1902.) Price 1*s.* 6*d.*

THIS is a reading book for young children. Its object is, the author says in his preface, "to bring before children's minds their own relation to the natural world in such a way as to appeal to imagination and reflection." The lessons will probably prove interesting to those for whom they are intended, but they do not sufficiently encourage the child's own activity. It is not enough to tell young pupils about natural objects; they should be encouraged to observe for themselves, instead of being content with the descriptions of others.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Waste of Energy from a Moving Electron.

THE subject of the dynamics of a moving charge being of considerable interest now, I have thought the following may be useful. I have shown that a charge Q on a sphere of radius A, when suddenly jerked into motion at speed u, generates a spherical electromagnetic shell of depth 2A, in which the magnetic force H tends to the value given by

$$2AH = \frac{Q}{4\pi R}\,\frac{u\sin\theta}{1-\frac{u}{v}\cos\theta}, \qquad (1)$$

when R, the distance from the initial centre of Q, is great. Along with this H, we have perpendicular electric force in the shell, according to $E=\mu vH$, or vectorially, $\mathbf{E}=V\mathbf{vB}$, if $\mathbf{v}$ is the vector velocity of the shell. The angle θ is that between $\mathbf{u}$ and $\mathbf{R}$. The energy wasted by this shell equals the energy left behind, that is, $U-U_0+T$, if U_0 is the initial, U the final electric energy in the field, and T the final magnetic field energy. On its first formation, $\mathbf{H}$ and $\mathbf{E}$ in the shell are different; they then include in accumulated form all the $\mathbf{H}$ and $\mathbf{E}$ which are left behind by the shell as it expands. The applied force impulse follows from my formula for the force on the ether, viz. $\mathbf{F}=(d/dt)V\mathbf{DB}$ per unit volume. Denoting the time integral by $\mathbf{M}$, then $\mathbf{M}=\mathbf{M}_1+\mathbf{M}_2$, where $\mathbf{M}_2$ belongs to the shell ultimately, and is lost, whilst $\mathbf{M}_1$ is left behind in the field. We have $T=\frac{1}{2}M_1u$ and $U-U_0=\frac{1}{2}M_2u$; so that altogether

$$\tfrac{1}{2}Mu = U-U_0+T. \qquad (2)$$

Both $\mathbf{M}_1$ and $\mathbf{M}_2$ are parallel to $\mathbf{u}$.

If, now, a second impulse acts, changing the velocity from $\mathbf{u}_1$ to $\mathbf{u}_2$ say, another spherical shell is generated. Disregarding the part left behind, (1) above shows that the magnetic force in it is

$$2AH = \frac{Q}{4\pi R}\left(\frac{u_2\sin\theta}{1-\frac{u_2}{v}\cos\theta}-\frac{u_1\sin\theta}{1-\frac{u_1}{v}\cos\theta}\right), \qquad (3)$$

when the direction does not change. More generally, substitute the vector change in the quantity on the right side of (1) properly vectorised. Then the change in θ will be allowed for as well.

The energy lost in this second shell may be calculated by (3). It amounts to

$$\left\{\frac{u_2P_2-u_1P_1}{u_2-u_1}\left(1-\frac{u_1u_2}{v^2}\right)-P_0\right\}Q, \qquad (4)$$

where P is the potential function

$$P=\frac{Q}{4\pi Ac}\left(1+\frac{1}{3}\frac{u^2}{v^2}+\frac{1}{5}\frac{u^4}{v^4}+\ldots\right) \qquad (5)$$

investigated by Searle and Morton. Take $u=0$, u_1 and u_2 to obtain P_0, P_1, P_2. It may be shown that the substitution of two impulsive changes in the same direction for a single one reduces the waste; that is, the one impulse u_2 wastes more energy than the two successive impulses u_1 and u_2-u_1. In fact, the saving is great, and ten equal partial impulses in succession waste not much more than one-tenth part of that wasted by a single impulse of size equal to their sum. There is a residuum, however, and that is what appears as continuous waste when u varies continuously.

When Δu is small

$$2AH=\frac{Q}{4\pi R}\,\frac{\sin\theta\,\Delta u}{\left(1-\frac{u}{v}\cos\theta\right)^2}, \qquad (6)$$

and now the waste of energy in the shell wave corresponding to Δu is

$$\frac{\mu Q^2}{12\pi A}\,\frac{(\Delta u)^2}{\left(1-\frac{u^2}{v^2}\right)^2}. \qquad (7)$$

The magnetic force in the above shells is uniform in the depth of the shell, when the impulse acts strictly at the front of a shell.